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Ellis Booker. **InternetWeek**. Manhasset: Sep 13, 1999. p. PG.1
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Stephan Ohr. **Electronic Engineering Times**. Manhasset: Aug 23, 1999. p. 49 (2 pages)
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Think-Tank Vision: More 'Comfortable' Connectivity -- Please Sit Down In My Network

Ellis Booker. *InternetWeek*. Manhasset: Sep 13, 1999. , Iss. 780; pg. PG.1

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Abstract (Article Summary)

Wireless digital assistants, network-attached refrigerators, and smart houses are examples of pervasive or ambient computing. IBM's Pervasive Computing Division, MIT's Media Laboratory, Andersen Consulting's Center for Strategic Technology Research and Microsoft's Hardware Devices Group are some of the outfits trying to figure out this future of computing, based on trends in software, hardware, and above all, networking. All are zeroing in on the implications of a world in which there are perhaps a trillion network-connected devices.

Full Text (1466 words)

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Those pocket-sized wireless digital assistants hitting the market are just the first wave of a network-connected world that's taking computing beyond the office and the home.

Future computing devices likely won't even resemble the equipment associated with today's networks. Consider a network-attached refrigerator that continually inventories its contents and accumulates ads from grocery services. Or maybe you'd prefer a "virtual house" that updates its contents whenever you buy merchandise on the Net or in person, and that you can walk around in with the aid of a virtual reality headset.

Such scenarios fall under the category of "pervasive" or "ambient" computing, and it's not just gee-whiz thinking. IBM's Pervasive Computing Division, MIT's Media Laboratory, Andersen Consulting's Center for Strategic Technology Research and Microsoft's Hardware Devices Group are some of the outfits trying to figure out this future of computing, based on trends in software, hardware and, above all, networking.

All are zeroing in on the implications of a world in which there are perhaps a trillion network-connected devices, in which "mobile computing" is anachronistic. Computing will be everywhere, embedded in all sorts of man-made things.

"There will a heterogeneity of devices with different form factors, uses and core technologies," said Aje Gopal, director of technology in IBM's Pervasive Computing unit, formed in February.

According to Giga Group, the mobile market is growing faster than the desktop and notebook PC markets. Sales of

handheld devices are expected to outstrip sales of notebook PCs by 2001. Some analysts predict that by 2003 half the devices connected to the Internet will not be PCs.

One marker for these developments is the Wireless Application Protocol (WAP), which is even now turning next-generation cellular telephones into terminal devices able to access the very same shopping, reservation and stock-trading systems that today are routinely accessed by desktop machines.

But a cell phone standing in for a PC is just the beginning, according to researchers.

"One part of this is simply moving computing away from the screen, workstation and work model, and making it part of everyday life," said Andy Lippman, MIT Media Lab's assistant director.

Hiroshi Ishii, an associate professor at the Media Lab, is working on subtle ways to add information to the physical environment. In one demonstration of this approach, motorized pinwheels speed up or slow down, depending on the amount of network traffic in the lab. The breeze created quickly conveys the network's load.

Ishii calls this "ambient computing," or moving I/O into the larger environment. "It's as much an issue of design as technology," said Lippman. "One sign of a mature technology is that design becomes important."

"What we call 'situated computing' will be cheap and pervasive," said Anatole Gershman, an associate partner in Andersen Consulting's Center for Strategic Technology Research. One recurring theme for CSTaR's work is to consider the sorts of services that will be enabled and suitable for this world.

The 30 people in the Northbrook, Ill., CSTaR facility test some concepts as part of their own daily routine—a taste of things to come.

One technology they're working with is a Video Wall that combines high-quality audio and video for inter-office connectivity.

Researchers in charge of the Video Wall talk about future phases of the project in which, using intelligent software agents, employees can be "found" and video calls routed or forwarded to wherever they are located at that moment.

Definitely more than science fiction-like speculation, Andersen's group and others are also focusing on how such a brave new world will impact commerce.

For instance, if computing is everywhere, will current models of Internet e-commerce be extended or obviated? And, if every piece of office furniture or clothing can be tracked, its usage and user noted, what downstream impact will this have on the production and sale of furniture and clothing?

No one has complete answers yet, but these researchers offer a few suggestions for what IT staffs should be thinking about today to prepare for this future (see sidebar).

Shopper's Helper

One of CSTaR's commerce-related demonstrations, called Shopper's Eye, explores how a wireless PDA, equipped with a Global Positioning System (GPS) identity, could be a major addition to a stroll through a shopping mall.

In this scenario, as the shopper walks through the mall, Shopper's Eye could notify a retailer that the shopper is five stores away, wants to purchase an alarm clock, prefers a particular brand and wants to spend only \$20.

Shopper's Eye collects custom offers from each retailer, then presents these offers to potential shoppers at the perfect time, when they are close to the physical store.

Making computing technology extremely cheap is another avenue of development the labs are pursuing. One of the MIT Media Lab's most exciting recent developments is in the area of electronic ink. Associate professor Joseph Jacobson, who has already demonstrated electronic ink-paper "printed" with microencapsulated particles that can change between black and white in the presence of an electric charge. Jacobson's now looking into printing

transistors, diodes and other basic computing elements onto paper.

"If you can print a display and connections and circuitry, you have a computer on a sheet of paper," Lippman said. Part of the breakthrough of such a technology, he said, will be in its extremely low price, low enough to make computing a true commodity available to anyone on the planet.

But before devices can be widespread, some fundamental questions about how to network them will have to be decided, said Turner Whitted, a senior researcher with Microsoft's 18-month-old Hardware Devices Group.

Whitted thinks that, given the power constraints of the small devices, the best networking scheme might be hierarchical, with devices talking to their nearby neighbors using a variety of protocols rather than communicating directly to a central server via IP.

"I have heard of IP everywhere, but I'm not sure I believe it, or that it's essential," Whitted said. "If you started from scratch, with low-power, wireless devices communicating with their near neighbors...it's not clear IP is the way to go." Such a hierarchy of connectivity, based on proximity, may suggest different forms of networking, according to Whitted.

Beyond power and networking, designers of these future systems will need to make them aware of their user's identity and location.

"These are straightforward. But another thing you might need the computer to know is your 'state,' whether at work, hurried or sleeping," Whitted said. "For example, if you're walking rapidly down the hall, the wallpaper doesn't need to interrupt you to tell you you have e-mail."

Another big area will be the "transcoding technologies," according to IBM's Gopal. These are the intermediary technologies that enable devices to communicate with the network, and one information network to communicate with another.

"You'll need a level of intermediation and support," Gopal said, arguing that this will probably be provided by carriers and other network service providers. In addition, he said, users will want the ability to "use a PDA, move to the car, then back to the office" without having to restart their work or connect to different backends.

In other words, not only will devices be pervasive, but they will also have to be cognizant of the fact that their human users will be switching modes during the course of the day and adjust themselves accordingly.

But the notion of multiple devices working in harmony may start with a less fanciful application—say, power consumption. MIT's Lippman noted that at least one brand of high-end kitchen appliances, sold in Italy, can regulate their combined consumption, and so keep the consumer from incurring fees for peak power use.

It seems clear that as networking and computing are added to conventional objects, such as kitchen appliances, a host of ancillary services will crop up. The refrigerator that's aware of its contents and can communicate with a grocery store for automated restocking may not be that far off. (Such an implementation is being tested in the United Kingdom.)

Many of the researchers concur that once this infrastructure is in place, new services will arrive. For example, once the car becomes a "platform" that's connected persistently to the network, car dealerships and manufacturers will form different relationships with drivers and each other.

Best of all, from an IT and business perspective, is the potential to create new services, such as automatic restaurant reservations along your car's route.

"These models will be possible because pervasive computing enables different constituencies to form a value chain, bringing previously disparate entities together," IBM's Gopal said.

It seems clear that the world of pervasive devices won't arrive in one fell swoop. WAP-enabled cell phones, standing in for PCs, may be the first sea-change, but these will be followed by other devices and services.

Andersen's Gershman puts it this way: "Someone once said, 'The future is here, but unevenly distributed.'"

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